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IS : 2597 ( Part IV ) - 1970

# *Indian Standard*

# CODE OF PRACTICE FOR THE USE OF ELECTRONIC VALVES

## PART IV CATHODE-RAY TUBES

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 1

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*July* 1970

# *Indian Standard*

# CODE OF PRACTICE FOR THE USE OF ELECTRONIC VALVES

## PART IV CATHODE-RAY TUBES

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( *Continued on page* 8 )

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# *Indian Standard*

# CODE OF PRACTICE FOR THE USE OF ELECTRONIC VALVES

## PART IV CATHODE-RAY TUBES

## 0. FOREWORD

**0.1** This Indian Standard (Part IV) was adopted by the Indian Standards Institution on 30 March 1970, after the draft finalized by the Electron Tubes and Valves Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** This standard is intended to give general guidance to the designers of electronic equipment to be supplemented by data sheets from the valve manufacturers so that optimum efficiency, performance, life, etc, can be obtained.

**0.3** This standard deals with the additional aspects that are to be covered in the use of cathode-ray tubes, such as oscilloscopes, and radar display tubes. The general and other more common aspects have already been dealt in IS:2597 (Part I)-1964* which is a necessary adjunct to this standard. The provisions laid down in this standard are additional to and should be read in conjunction with IS:2597 (Part I)-1964*.

**0.4** This standard is based, to a large extent, on B.S.CP 1005:1962 'Code of practice for the use of electronic valves' issued by the British Standards Institution.

**0.5** This standard is one of a series of Indian Standards on codes of practice for the use of electronic valves and tubes. Other standards so far published in this series are:

IS:2597 (Part I)-1964 Code of practice for the use of electronic valves: Part I Commercial receiving valves
IS:2597 (Part II)-1967 Code of practice for the use of electronic valves: Part II Special quality valves
IS:2597 (Part III)-1969 Code of practice for the use of electronic valves: Part III Transmitting and industrial valves

## 1. SCOPE

**1.1** This standard (Part IV) deals with the code of practice for the use of cathode-ray tubes used in cathode-ray oscilloscopes, radar display units, etc.

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*Code of practice for the use of electronic valves: Part I Commercial receiving valves.

## 2. TERMINOLOGY

**2.0** For the purpose of this standard, the definitions contained in IS:1885 (Part IV/Sec 1) - 1965* and IS:2597 (Part I) - 1964† shall apply.

## 3. DIMENSIONS

**3.1** Particular care should be taken to examine the manufacturer's published outline drawings and any notes thereon referring to variants of bulb contour, positions of h.t. connectors or side arms, position of grid aperture, etc. While designing the equipment, reliance should not be placed upon dimensions taken from individual tubes.

## 4. RATINGS

**4.1 General** — Cathode-ray tubes usually have minimum as well as maximum extra high tension (e.h.t.) voltage ratings; it does not follow that operation at the minimum rating will necessarily improve performance or life; frequently the reverse will occur. A low e.h.t. voltage may result in uneven brightness of the screen in the case of certain types of tubes and the quality of the focus may also be impaired. At reduced e.h.t. voltages the screen performance may deteriorate in life more rapidly although for the same cathode current the life of the cathode may be improved. It is, therefore, emphasized that the end use and recommendations of the manufacturers should be kept in view in the operation of cathode-ray tubes.

**4.2 Frequency Limitations** — The performance of cathode-ray tubes is not independent of frequency. At high frequencies, special tubes or circuits may be required and the manufacturer should be consulted. The effects of grid-cathode capacitance, deflection-plate capacitance and transit time become increasingly important at such frequencies.

## 5. HEATER VOLTAGE REGULATIONS

**5.1 General** — Cathode-ray tube heaters may be more critical to voltage regulation than some other types of heaters and in consequence may require more mains tappings [*see* **3.4.2.2** of IS:2597 (Part I) - 1964†]. The manufacturers should be consulted for any particular recommendations.

**5.2 Series Operation** — In general, cathode-ray tube heaters have thermal characteristics different from those of normal receiving valve heaters, and in case of series operated tubes a maximum surge voltage rating may be specified, or it may be ensured that the heater-current always falls within ± 2·5 percent of the published value when tubes with normal heater characteristics are employed and the series circuit is connected to the highest or lowest nominal mains voltage range. Particular care should be taken to see that the voltage surge does not exceed the maximum rated value during initial switching on, during the warm-up period, or in the event of the equipment being switched on soon after it has been switched off.

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*Electrotechnical vocabulary: Part IV Electron tubes and valves, Section 1 Receiving valves.

†Code of practice for the use of electronic valves: Part I Commercial receiving valves.

## 6. MOUNTING

**6.1** Any desired angle of mounting may be adopted except that if the tube is mounted with screen upwards under conditions of excessive vibration the life may be shortened owing to loosened screen material falling on the cathode.

**6.1.1** The mounting of cathode-ray tubes should have some flexibility; no stresses should exist between the bulb and the neck or between the side arms and any part of the tube. It is desirable, particularly with magnetic-deflection tubes where the neck diameter is small compared with that of the bulb, the holder should in no way act as a support for the tube.

**6.2** The connections to cathode-ray tube holders or e.h.t. side connections should not only be flexible but also be of sufficient length to permit rotation of the tube and holder so that the trace can be oriented in the required axis. Any external conducting coating should never be left disconnected where it is specified that it should be earthed, and particular care should be taken that good contact is assured, especially under vibration.

**6.3** Adequate insulation should be provided between the tube and any auxiliary equipment, such as deflector coils; otherwise undesirable results due to leakage through the glass or due to electrostatic charges or discharges may arise. This precaution becomes increasingly important at higher operating voltages.

**6.4** Precautions for protection against stray electrostatic or magnetic fields, particularly the latter, are very important with cathode-ray tubes the operation of which is dependent upon the control of the exact position of an electron beam on the screen; this is of maximum significance in mobile equipment the calibration of which may be influenced even by the earth's field. Hence they should be positioned and/or shielded so that the deleterious effects of such fields are reduced to a minimum.

**6.4.1** The electron stream may be deflected or modulated by the stray fields from transformers, loudspeaker magnets, high potential components and wiring thus adversely affecting the operation of controlling electrodes. Tubes with directly heated cathodes are particularly susceptible to such effects.

## 7. HANDLING

**7.1** The precautions taken in manufacture reduce the possibility of spontaneous implosion to a minimum but any additional stress due to mishandling considerably increases the risk of implosion. Such implosion may occur immediately, or may be delayed. Particular care should be taken not to scratch any part of the cathode-ray tube bulb, particularly the viewing face, as this will appreciably reduce the strength of the glass and may lead to implosion of the tube, often after a delay.

**7.2** Care should be taken to prevent bumping or striking the rim round the face of a tube having a metal cone as rough treatment may damage the glass-to-metal joint. When a tube is not in its equipment or original packing, it should be placed screen downwards on a soft pad of suitable material free from abrasive substances. Tubes with relatively small necks and large bulbs should be handled by the bulb end. When it is necessary to handle the tube by the neck, great care should be taken to avoid sideways leverage and the bulb should be supported when possible.

**7.3** In the case of tubes having metal cones, it is important to prevent the cone coming into contact with a magnet and thus becoming permanently magnetized. A magnetized cone produces localized distortion of the picture edges.

**7.4** Attention is called to the fact that a high voltage charge may be carried by the external conducting coating on the glass bulb, even after a tube has been removed from equipment. Anyone handling such a tube may receive a shock, which while generally not dangerous to the person, might cause an involuntary reaction resulting in damage to the tube, which might, for example, be dropped.

**7.4.1** The external coating forms part of a capacitor which should be discharged by connecting it to the final anode terminal before handling. Further charges may build up while any strain remains in the dielectric and the above precaution is advisable before the tube is handled on each occasion.

## 8. VENTILATION

**8.1** Equipment should be so designed that adequate ventilation is provided to ensure safe bulb temperature under all conditions. For tubes using electromagnetic deflection and focussing, special attention should be given to ventilation in the vicinity of the coils which may over-heat the neck with consequent risk of reduced tube life. Adequate ventilation of holders or side contacts becomes increasingly important at higher operating voltages as corona ionization may cause breakdown.

## 9. CONTROL GRID VOLTAGE

**9.1** The resistance between the control grid and cathode should be kept as low as possible in conformity with the value specified by the manufacturer. If unduly high values of grid resistance are used, the presence of grid current due to leakage may produce a variation or in extreme cases, a loss of brightness control.

**9.2** Cathode-ray tubes should not be used in any application which results in the production of positive grid current; normally no cathode-ray tubes should operate even instantaneously at a grid-cathode voltage more positive than – 1 V. In order to ensure that the above limitation is not exceeded, it may be necessary to include a low impedance diode in the circuit when a grid is pulsed for brightness modulation.

**9.3** Care should be taken in the design of circuits to ensure that there is ample negative bias available to cut-off the beam current, circuit design should take account of the regulation of the h.t. supply and of the upper limit of cut-off voltage for the tube.

## 10. VOLTAGES ON ELECTRODES INTERMEDIATE IN POTENTIAL BETWEEN CATHODE AND FINAL ANODE

**10.1** These electrode voltages should be obtained either from a voltage divider with good regulation characteristics or direct from some other sources, the voltage of which is controllable within suitable limits. Series resistance can seldom be used for voltage dropping purposes because of the intermediate electrode currents which vary in polarity and also vary considerably in magnitude, particularly towards the more positive end of the grid modulation range.

## 11. SPECIAL CONSIDERATIONS

### 11.1 Cathode and Screen Protection

**11.1.1** At all times it is desirable to keep the brightness level and beam current to the lowest practicable value to obtain optimum life. This is particularly important when the tube is operated with a stationary or slow-moving spot; otherwise permanent damage may be done to the screen.

**11.1.2** Where the positive voltage on any electrode exceeds 2·0 kV a series limiting resistor should be inserted as close as possible to the electrode connection concerned and be of such a value that the transient short-circuit current does not exceed 100 mA on flashover; where the insertion of such a resistor may affect waveforms, as in deflector plate circuits in electrostatic tubes, a compromise value should be used after consultation with the manufacturer.

**11.1.3** By a suitable choice of the time constants of the anode and grid ( modulator ) supply networks, the bias voltage should be prevented from decreasing more rapidly than the anode voltage when the equipment is switched off. Conversely, at switching on, the anode voltage should be prevented from increasing more rapidly than the bias voltage. In addition, before current is drawn from the cathode, it is normally essential that deflection voltages should be applied to a tube. If these precautions are not observed, excessive current may cause burning of the screen or damage to the cathode.

### 11.2 Trace Stability

**11.2.1** In tubes where measurements are made directly on the tube-screen face, the final anode should be earthed or maintained at the mean point of the deflecting system to minimize the effect of capacity and leakage on the stability of the trace.

**11.2.2** The external dc resistance between any deflector plate and the final anode of an electrostatic deflection tube should be as low as possible. The use of unduly high values is likely to cause instability of the trace with variations of brightness.

### 11.3 Magnetic Deflection and Focussing

**11.3.1** Neck shadowing resulting in the loss of useful screen area, can arise from the use of the deflector coil of incorrect length or from failure to locate the coil sufficiently forward on the tube neck. Shadowing can also result from bad focussing or stray fields.

**11.3.2** For tubes using magnetic focussing, care should be taken to locate the magnetic centre of the field in the recommended position with respect to the grid aperture or other reference plane. Otherwise an excessive focus coil current may be required or a deterioration of focus uniformity may be produced.

### 11.4 Electrostatic Deflection and Shift

**11.4.1** In conventional electrostatic deflection tubes the most satisfactory results are normally obtained with symmetrical deflection; asymmetrical deflection of both axis is not recommended if good focus uniformity or deflection linearity is required, except with tubes specifically designed for such operation.

**11.4.2** In the design of the deflection and shift circuits of electrostatic deflection tubes, account should be taken of the voltage/current characteristics of the deflector plates.

NOTE — In some tubes the deflector plates may take current which results in a non-linear relationship between the voltage applied to the deflector plate and the movement of the spot.

**11.5 Light Filter** — Separate light filters are sometimes employed to improve contrast in the presence of ambient light. It is undesirable to compensate any loss of brilliance by increasing the beam current as such compensation may be sufficient to reduce the life of the tube. Where the tube ratings permit, compensation should be made by the use of a higher final anode voltage.

**11.6 Ultra-Violet Excitation** — Certain screens containing materials which fluoresce under ultra-violet excitation should be protected by shields or filters where necessary. In cases of doubt concerning this screen characteristic the manufacturer should be consulted.

## 12. STORAGE AND TRANSIT

**12.1** It is very important for cathode-ray tubes not installed in the equipment to be stored in their original packing or in suitable racks.

**12.2** Normal good storage conditions should be provided to prevent deterioration, such as corrosion of contacts or impairment of electrical insulation.

**12.3** The tube should preferably be transported in the original packing designed for the purpose.

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( *Continued from page* 1 )

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# AMENDMENT NO. 1 AUGUST 1973
# TO
# IS : 2597 ( Part IV )-1970 CODE OF PRACTICE FOR THE USE OF ELECTRONIC VALVES

## PART IV CATHODE-RAY TUBES

### Alterations

( *First cover page*, *pages* 1 *and* 2, *Title* ) — Substitute the following for the existing title:

‘ *Indian Standard*

**CODE OF PRACTICE FOR THE USE OF ELECTRON TUBES**

**PART IV CATHODE-RAY TUBES’**

Substitute ‘electron tubes’ *for* ‘electronic valves’ and ‘electron tubes and valves’ wherever it appears in the standard.

Substitute ‘ tube ’ *for* ‘ valve ’ wherever it appears in the standard.

( ETDC 39 )

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